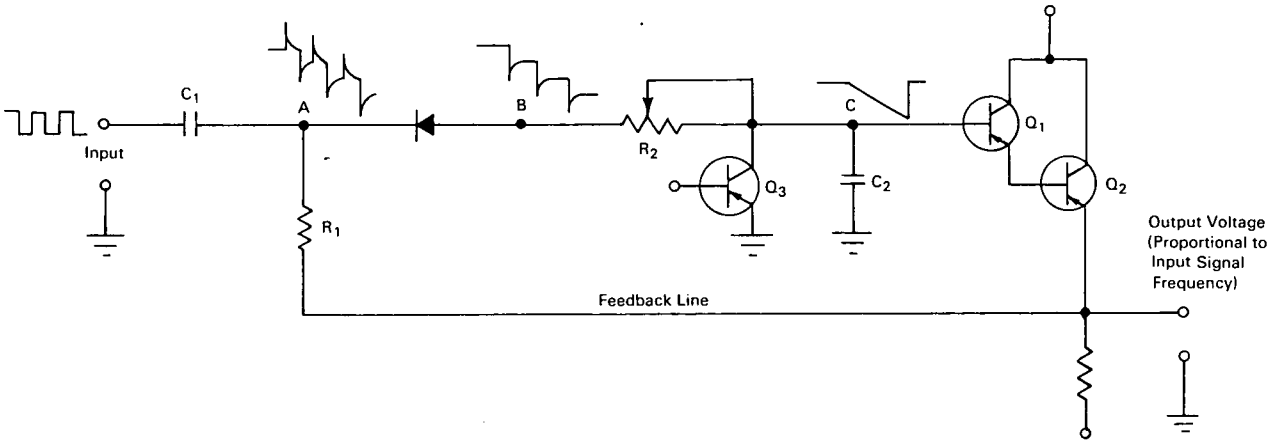
# NASA TECH BRIEF



## Simple Circuit Functions as Frequency Discriminator for PFM Signals




**The problem:** To monitor the frequency of PFM (pulse frequency modulated) telemetry signals. The frequency discriminator to be used for this purpose must be less complex than conventional discriminators or frequency counters.

**The solution:** A simple circuit whose output voltage is directly proportional to the input frequency and which provides a means for rapidly sampling particular frequency channels.

**How it's done:** The discriminator consists of four simple branches: a differentiator ($C_1$, $R_1$), a variable time-constant integrator ($R_2$, $C_2$), a transistor dump switch ($Q_3$), and a Darlington-type common-collector transistor amplifier ($Q_1$, $Q_2$).

The PFM signal is shaped by a one-shot multivibrator (not illustrated) to produce square wave pulses of constant pulse width and at a repetition rate equal to the frequency of the PFM signal. These square wave pulses are applied to the discriminator input. The differential waveform shown at point A, appears as negative going pulses at point B. The variable time-constant integrator averages these pulses into a single negative-going spike at point C. Transistors $Q_1$ and $Q_2$ offer a high impedance to $C_2$ and thereby prevent its discharge. The potential on the emitter of $Q_2$ follows the potential of $C_2$ during charging of this capacitor. The feedback line from the common-collector amplifier provides a reference voltage for $R_1$. As the feedback line becomes more negative, the reference voltage and point A also become more negative, with the result that the voltage across $R_2$ is always at the voltage amplitude of the incoming pulse. During integration, therefore, a constant current is supplied to $C_2$, charging it at a linear rate. Transistor $Q_3$ acts as a dumping switch which can be controlled to maintain $C_2$ in an uncharged condition until the channel to be sampled is selected.

(continued overleaf)

**Notes:**

1. The output of the discriminator can be applied to a strip chart recording oscillograph for permanent recording of the sampled frequencies.

2. The discriminator should be useful as a constant-current integrator for various applications, such as in linear sweep circuits and time delay circuits.

3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10102

**Patent status:** NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: James Billingsley
(GSFC-267)